2007 SURVEY OF THE RECREATIONAL COD FISHERY OF NEWFOUNDLAND AND LABRADOR

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for

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Introduction

The province of Newfoundland and Labrador offers almost unlimited opportunities for residents to participate in the recreational cod fishery. There are over 9,600 km of coastline on the more heavily populated main island and outer islands, and almost 7,900 km of coastline on the sparsely populated mainland area of Labrador. More than half the population lives in small villages dotting the coastline. With the exception of a small number of communities (e.g., Grand Falls-Windsor, Gander, Deer Lake, Labrador City, Wabush), the larger villages, towns and cities are also on the coastline of the province.

With such close ocean access, anglers can choose to fish in almost any bay or on any coastal stretch within easy reach of their residences. Since the late 1990s, fishing for cod during openings of the recreational fishery has been the pursuit of tens of thousands of resident anglers in the province.

With the 2007 opening of the fishery came a pledge by the Minister of Fisheries and Oceans, Loyola Hearn, to conduct a post-season survey of catch and effort in the recreational cod fishery. It was considered essential, given the number of participants in the fishery, that an assessment of activity and success in the fishery be undertaken, in addition to normal surveillance of the fishing activity by DFO patrols. This report provides highlights, summary statistics and detailed information tables on all aspects of the survey.

Survey Highlights

In the 2007 recreational cod fishery in Newfoundland and Labrador:

- The season was five weeks long: July 25 to August 19 and September 29 to October 7
- 73,425 anglers participated in the five-week fishery
  - 65,443 anglers were 16 years of age and older; 7,982 were under 16 years of age
  - 63.9% of anglers were male; 36.1% were female
  - for anglers 16 years of age and older, males averaged 51 years; females, 47 years
  - almost 42% lived on the Avalon Peninsula
- anglers fished for an estimated 300,240 days, or for 4.1 days on average over the season
  - 58% of days were fished in NAFO sub-division 3L; followed by 25% in 3K
  - over 41% of the days fished were by residents of the Avalon Peninsula
  - over 29% of anglers fished only one day during the season
- anglers caught an estimated 1.2 million cod
  - they caught an average of almost 16.4 fish each during the fishery
  - 47% caught 5 fish per day fished
  - 54% harvested 10 fish or less
  - they caught 4.0 cod per day fished
  - cod caught in Trinity, Notre Dame, Bonavista and Conception Bays accounted for two-thirds of the total cod harvest

Figure 1: Census Divisions and Residence Areas of Newfoundland and Labrador

Map Source: Statistics Canada

Concepts, Terms and Definitions

Following is a glossary of terms and definitions used in the survey and throughout this report:

Recreational Fishing: refers to non-commercial fishing; angling and sport fishing are covered in the definition used by the survey. Note that ceremonial fishing and subsistence fishing are not covered by the survey and are, therefore, not included in any of the estimates presented in this report.

Angler: an individual of any age who fished for cod in the recreational fishery in 2007; the identification of active anglers was based on the information obtained from the results of the survey pre-screening and the responses of individual respondents. A licence to fish for cod in the recreational fishery in 2007 was not required.

Adult Anglers: the adult angler population in 2007 who were 16 years of age and older. Most survey results presented in this report relate to recreational fishing activities of ***all*** anglers in NL with some specific tables relating only to ***adult anglers***.

Household: made up of one or more adult anglers who reside in the same dwelling.

Cod Caught: number of cod caught and retained by anglers.

Day Fished: a day or part of a day on which an angler fished for cod.

Cod: refers to Northern cod (gadus morhua)

Wolffish: refers to any of the species of wolffish in Atlantic Canada listed as threatened or of special concern under the Species at Risk Act; namely, northern (threatened), spotted (threatened) and striped (special concern)

NAFO Sub-division: specific geographic boundaries within Canada as determined by the Northwest Atlantic Fisheries Organization in its Convention areas. All data presented by NAFO sub-division refers to where the fishing activity occurred.

Census Division (CD): geographic areas set by Statistics Canada, which are used during the conduct of the Census of Population for Canada. NL has 11 such areas and, for the purposes of sample selection, the two CDs for Labrador were combined (Table 1). Also for purposes of reporting, these CDs were named for general geographical areas of the province (see Map of Newfoundland and Labrador)

Residence areas: for ease of reporting information based on where anglers lived, the 10 CDs were recoded into six major geographical areas, representing specific coastal and associated inland areas of the province (Table 2).

Note:

Resource Management National, Fisheries and Aquaculture Management, DFO, should be cited as the source of data provided, unless otherwise indicated.

Totals may not add due to rounding.

Survey Overview

The 2007 Survey of the Recreational Cod Fishery of Newfoundland and Labrador was the first survey specifically designed to collect information on this fishery. In his June 22nd News Release announcing the opening dates of the fishery, the Minister of Fisheries and Oceans, Loyola Hearn, indicated that a post-season survey of the fishery would be conducted. The season was closed as of October 8th and the survey began October 18th. Bristol Group of St. John's conducted interviews over a three-week period, ending November 8th.

The number of households sampled within each of Statistics Canada's Census Divisions of Newfoundland and Labrador (NL) are provided in the table below:

Table 1 Sample Sizes, by Census Division, 2007

Census Divisions	Households Sampled
Division 1 - Avalon Peninsula	1,409
Division 2 - Burin	404
Division 3 - South Coast	405
Division 4 - Southwest	401
Division 5 - West Central	405
Division 6 - Central	405
Division 7 - Bonavista	407
Division 8 - Northeast Coast	409
Division 9 - Northern Peninsula	406
Division 10 - Labrador	404
Total	5,055

For ease of reporting survey results, based on the residence of anglers in the province, the 10 Statistics Canada's Census Divisions were grouped into six geographic or coastal areas as provided below:

Table 2 Sample Sizes, by Residence Area, 2007

Residence area	Households Sampled
Avalon Peninsula (Div. 1)	1,409
Burin - South Coast (Div. 2, 3)	809
West NL - Northern Peninsula (Div. 4, 5 9)	1,212
Central - NE Coast (Div. 6, 8)	814
Bonavista - Trinity (Div. 8)	407
Labrador (Div. 10)	404
Total	5,055

As shown in Appendix B, the survey collected information on:

- Household composition: males and females, under 16 years of age and those 16 years of age and older and the number of anglers in each of the four household groups
- Fishing activity
    - total days fished for cod by males and females under age 16;
    - total number of cod caught by these anglers (retention was mandatory);
    - the nearest town, bay or NAFO area where most of their activity occurred;
    - a randomly selected individual 16 years of age and older who fished for cod was asked:
        - the number of days fished;
        - the number of cod caught;
        - the nearest town, bay or NAFO area where most of their activity occurred;
        - if any wolffish were caught when fishing for cod and, if so, the number caught and the number successfully released back into the water; and
        - their age (sex was recorded based on the respondent selected).

Appendix A provides a more detailed description of the survey methodology as well as indicators of data quality and statistical reliability of key variables.

Survey Results

Summary statistics are presented in this section of the report. More detailed tables with information by residence area are presented in Appendix C.

Angler Profile

Over 41% of cod anglers lived on the Avalon Peninsula, with another 22.6% living in the Central and NE coast areas of the province. Given that almost 50% of all households in the province are on the Avalon Peninsula, the preponderance of anglers in this area was somewhat expected. As well, due to the limited access to coastal waters for most large communities in Labrador, the low percentage of cod anglers resident in Labrador was equally expected (Table 3).

Table 3 Number of anglers who fished for cod, by age category, by residence area.

Residence Area	Anglers < 16	Anglers 16+	Total	%
Avalon Peninsula	3,447	27,193	30,641	41.7
Burin-South Coast	432	4,949	5,380	7.3
West NL- N. Peninsula	739	5,956	6,695	9.1
Central-NE Coast	1,942	14,616	16,558	22.6
Bonavista-Trinity	1,151	10,599	11,750	16.0
Labrador	271	2,130	2,401	3.3
Total	7,982	65,443	73,425	

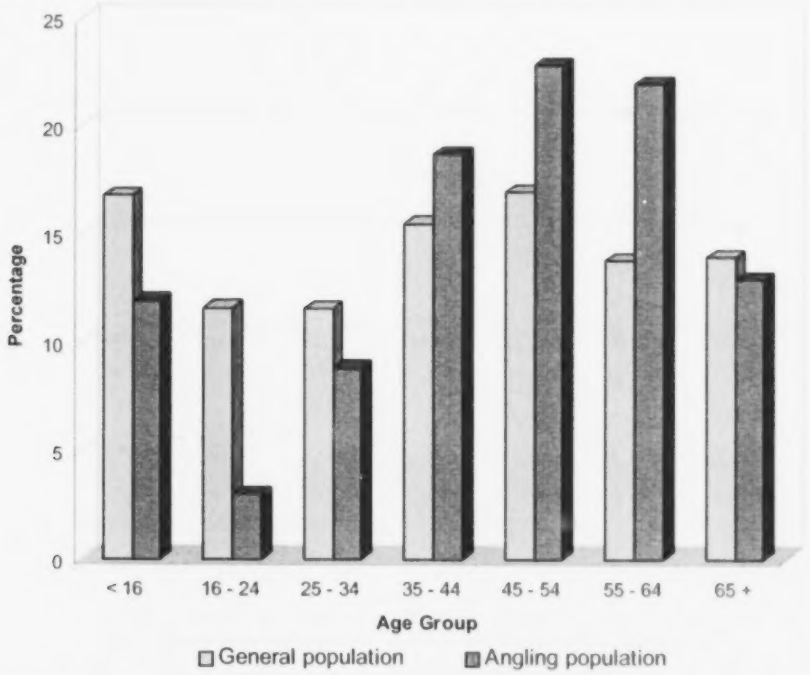
About 55% of cod anglers fished in NAFO sub-division 3L, with an additional 25% fishing in NAFO sub-division 3K (Table 4). With the provincial population living adjacent to NAFO sub-division 3L, the numbers of anglers fishing in this area was not surprising. However, the number of anglers fishing in sub-division 3K is slightly disproportionate to the population adjacent to this area (about 17% of the population lives adjacent to 3K). A check of anglers fishing in this sub-division showed that 22% of anglers fishing in this coastal area were visiting from other residence areas of the province. By contrast, just over 5% of anglers fishing in sub-division 3L lived outside the coastal areas adjacent to the sub-division.

Table 4 Number of anglers who fished for cod, by age category, by NAFO sub-division of activity.

NAFO Sub-Division	< 16	16+	Total	%
2J	109	1,046	1,155	1.6
3K	2,152	16,495	18,648	25.4
3L	4,538	36,011	40,549	55.2
3Pn	86	965	1,051	1.4
3Ps	600	5,889	6,489	8.8
4R	496	5,037	5,533	7.5
Total	7,982	65,443	73,425	

When compared to the general population, the representation of anglers younger than 35 years of age was lower than that found in the general population (Chart 1). Anglers under 35 represented about 23% of the angling population while this age group in the general population accounted for almost 40% of individuals in the province. For anglers between 35 and 64, however, their representation was considerably higher than individuals in this age group in the general population (64% compared to 46%). Anglers 65 years of age and over were fairly representative of that age group in the general population.

Chart 1 Comparison of the general and angling populations, by age group, 2007



Source: Statistics Canada, 2006 Census of Canada, Cat. No. 97-551-X2006013

Sex Profile

Males made up less than 49% of the population of NL (Table 5). About 11% of all cod anglers were < 16. In all residence areas except two, male and female anglers had lower representation than at the provincial level. For the two residence areas where this was not the case, Central-NE Coast and Bonavista-Trinity, the representation of male and female anglers was considerably higher than at the provincial level.

Table 5 Angler numbers and their representation in the population, by residence area.

	Males			Females		
Residence area	Population	Anglers	%	Population	Anglers	%
Avalon Peninsula	120,229	19,244	16.0	129,395	11,397	8.8
Burin-South Coast	19,772	3,632	18.4	20,403	1,748	8.6
West NL- N. Peninsula	39,126	4,751	12.1	41,313	1,944	4.7
Central-NE Coast	36,920	10,328	28.0	38,586	6,230	16.1
Bonavista-Trinity	17,480	7,525	43.0	18,193	4,225	23.2
Labrador	12,208	1,472	12.1	11,844	929	7.8
Total	245,735	46,952	19.1	259,735	26,473	10.2
%	**48.6**			**51.4**		

Of all anglers who fished for cod in 2007 almost 64% were male (Table 6). The highest representation of male anglers compared to female anglers was in the West NL-N. Peninsula residence area of the province. Other than in this residence area, the proportions of male and female anglers in the other residence areas were closer to the provincial levels.

Table 6 Number of anglers fishing for cod, by age category and sex, by residence area.

	Males			Females			All
Residence area	< 16	16+	Total	< 16	16+	Total	anglers
Avalon Peninsula	2,028	17,216	19,244	1,419	9,977	11,397	30,641
Burin-South Coast	255	3,377	3,632	176	1,571	1,748	5,380
West NL- N. Peninsula	538	4,213	4,751	201	1,743	1,944	6,695
Central-NE Coast	1,234	9,093	10,328	708	5,523	6,230	16,558
Bonavista-Trinity	740	6,785	7,525	412	3,814	4,225	11,750
Labrador	193	1,280	1,472	78	851	929	2,401
Total	4,988	41,964	46,952	2,994	23,479	26,473	73,425
%	10.6	89.4	**63.9**	11.3	88.7	**36.1**	

As noted above, the greatest number of anglers who fished for cod in 2007 in NL, fished in NAFO sub-division 3L. This behaviour was consistent among all four age-sex groups of anglers. The lowest number of participants in 2007 was in NAFO sub-division 3Pn, the smallest in area of all sub-divisions in NL (Table 7). And despite the vast area covered by NAFO sub-division 2J, as would be expected due its remoteness and the low population in areas adjacent to the sub-division, the number of participants was just marginally higher than in sub-division 3Pn.

Table 7 Number of anglers fishing for cod, by age category and sex, by NAFO sub-division of activity.

	Males			Females			All
NAFO Sub-Division	< 16	16 +	Total	< 16	16 +	Total	anglers
2J	83	646	728	26	400	426	1,155
3K	1,336	10,078	11,414	816	6,418	7,234	18,648
3L	2,862	22,730	25,592	1,676	13,281	14,957	40,549
3Pn	69	703	773	17	261	278	1,051
3Ps	327	4,343	4,670	273	1,546	1,819	6,489
4R	310	3,464	3,775	186	1,573	1,759	5,533
Total	4,988	41,964	46,952	2,994	23,479	26,473	73,425

Age Profile

Detailed ages were collected from anglers aged 16 years of age and older (Table 8). Adult male anglers averaged 51.2 years of age, while adult female anglers were more than 4 years younger, averaging 47.0 years of age. The adult anglers with the highest average ages, for both males and females, at 54.0 and 51.9 years respectively, lived in the Burin-South Coast area (Table 4.6). They were closely followed by anglers residing in the Bonavista-Trinity area, with the average age for male anglers at 53.8 and female anglers at 51.2. The youngest anglers participating in the 2007 NL recreational cod fishery lived in Labrador, with males averaging 46.3 years and females averaging 36.4 years.

Table 8 Average ages of cod anglers 16+ fishing for cod, by sex, by residence area.

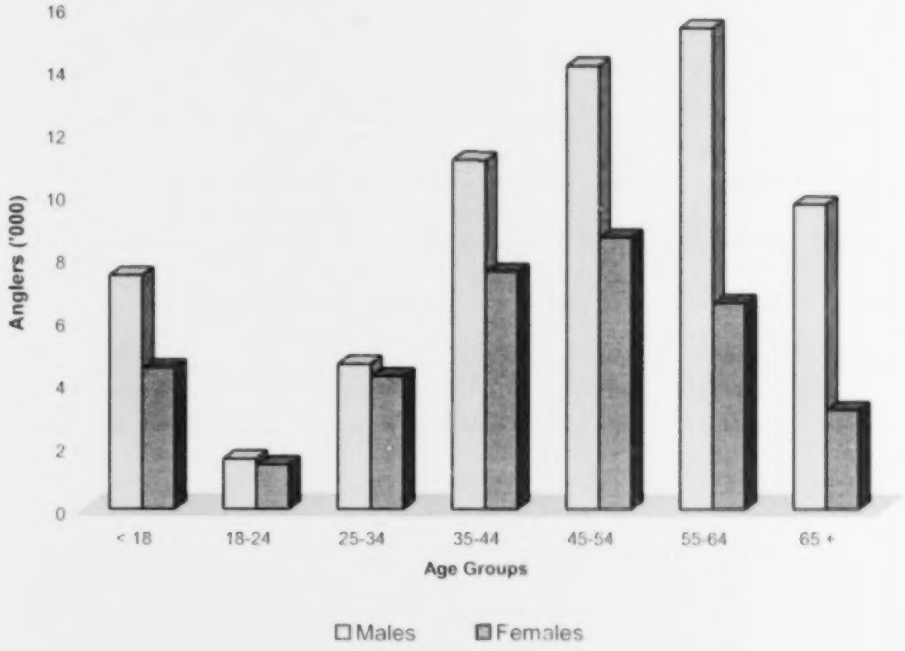
	Sex of angler		
Residence area	Male	Female	Total
Avalon Peninsula	48.9	44.5	47.3
Burin-South Coast	54.0	51.9	53.4
West NL- N. Peninsula	52.7	48.1	51.3
Central-NE Coast	52.5	48.6	51.0
Bonavista-Trinity	53.8	51.2	52.9
Labrador	46.3	36.4	42.4
Total	51.2	47.0	49.7

As would be expected, anglers fishing in NAFO sub-division 2J, bordering on Labrador, were the youngest of all anglers based on the area fished, averaging 46.0 years for males and 42.0 years for females (Table 9). Male anglers fishing in NAFO sub-division 4R were the oldest on average at 53.4 years of age. Female anglers fishing in NAFO sub-division 3Pn were the oldest, averaging 50.8 years on average. As can be seen in Chart 2, of all anglers by sex and age group, the greatest proportion of anglers, 15.5%, were males in the 55 to 64 years of age group. These male anglers represented 24% of all male anglers. The highest proportion of female anglers, 8.7%, was in the 45 to 54 years of age group, representing 24% of all female anglers.

Table 9 Average age of cod anglers 16+, by sex, by NAFO sub-division of activity.

NAFO Sub-division	Sex of angler		Total
	Male	Female	
2J	46.0	42.0	44.5
3K	51.7	46.6	49.7
3L	50.8	47.1	49.4
3Pn	46.6	50.8	47.8
3Ps	52.2	50.0	51.6
4R	53.4	46.0	51.1
Total	51.2	47.0	49.7

Chart 2 Distribution of cod anglers by sex and age-group.



Fishing Effort

The 2007 recreational cod fishery was open for a total of 35 days (July 25 to August19; September 29 to October 7). Overall, anglers fished what might be considered a low 4.1 days on average over the season (Table 10). The lowest average number of days fished was by anglers living in the West NL-N Peninsula area of the province. Those anglers residing in the Bonavista-Trinity area fished the highest average number of days, at 4.7 days per angler.

As would be expected, anglers who lived on the Avalon Peninsula spent the highest number of days fishing for cod, totalling over 124,000 days. The next highest number of days fished was by anglers residing in the Central-NE Coast area. The average number of days fished by anglers residing in three residence areas, Avalon Peninsula, Burin-South Coast and Central-NE Coast were all the same; all fished the provincial average of 4.1 days.

Table 10 Number and average days fished by age group, by residence area.

Residence area	Days fished			Average days fished		
	< 16	16 +	Total	< 16	16 +	Total
Avalon Peninsula	9,626	114,677	124,303	2.8	4.2	4.1
Burin-South Coast	1,662	20,335	21,998	3.9	4.1	4.1
West NL- N. Peninsula	2,280	20,137	22,416	3.1	3.4	3.3
Central-NE Coast	5,207	62,629	67,836	2.7	4.3	4.1
Bonavista-Trinity	3,040	52,121	55,161	2.6	4.9	4.7
Labrador	826	7,700	8,526	3.0	3.6	3.6
Total	22,641	277,599	300,240	2.8	4.2	4.1

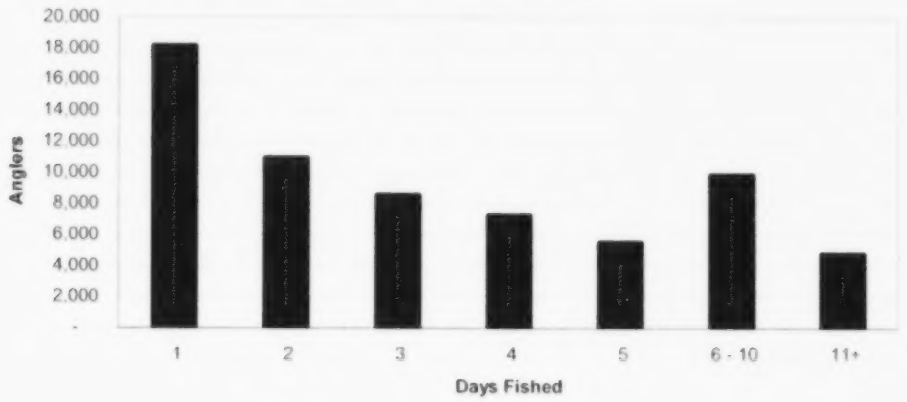
Overall angling pressure was greatest in NAFO sub-division 3L, where anglers spent a total of over 175,000 days fishing in 2007 (Table 11). Their fishing effort in this sub-division, on average 4.3 days, exceeded the provincial average of 4.1 days. The lowest number of days fished were in NAFO sub-division 2J, with just over 3,000 days being fished, or an average of 2.7 days per angler.

Table 11 Days fished and average days by age group, by NAFO sub-division of activity.

NAFO sub-division	Days fished			Average days fished		
	< 16	16 +	Total	< 16	16 +	Total
2J	294	2,770	3,065	2.7	2.6	2.7
3K	5,405	69,933	75,338	2.5	4.2	4.0
3L	13,290	162,115	175,404	2.9	4.5	4.3
3Pn	328	3,777	4,105	3.8	3.9	3.9
3Ps	1,611	23,151	24,762	2.7	3.9	3.8
4R	1,713	15,853	17,567	3.5	3.1	3.2
Total	22,641	277,599	300,240	2.8	4.2	4.1

As can be seen in Chart 3, just over 18,000, or 27.8% of the adult angling population, fished for just one day in the 2007 recreational cod fishery. The numbers of anglers fishing 2 days through 5 days fell off from almost 11,000 fishing for 2 days to almost 5,600. Almost 10,000 anglers fished between 6 and 10 days each, while another almost 4,850 anglers fished for 11 days or more. The highest number of days fished by any angler in the 2007 recreational cod fishery was 20 days.

Chart 3 Distribution of days fished for cod by number of participating adult anglers.



Harvest

Cod

In 2007, anglers of all ages caught 1.2 million cod in the NL recreational cod fishery (Table 12). As indicated above, anglers under 16 years of age accounted for about 11% of the angling population. These anglers caught an average of about 10 fish each, totalling just over 78,000 cod and accounting for only about 6.5% of the total catch. Anglers 16 years of age and older caught about 17 fish on average each, with a total catch of just over 1.1 million cod being harvested. Anglers under 16 years of age living in the Burin-South Coast area caught the most cod on average, at almost 14 fish each, while those living in the West NL-N. Peninsula area caught the fewest on average at about 8 fish each.

Table 12 Number and average cod caught by age category, by residence area.

Residence area	Cod caught			Average cod caught		
	< 16	16 +	Total	< 16	16 +	Total
Avalon Peninsula	37,818	453,712	491,531	11.0	16.7	16.0
Burin-South Coast	5,820	89,630	95,450	13.5	18.1	17.7
West NL- N. Peninsula	5,655	73,495	79,150	7.7	12.3	11.8
Central-NE Coast	15,922	246,953	262,875	8.2	16.9	15.9
Bonavista-Trinity	9,835	233,655	243,489	8.5	22.0	20.7
Labrador	2,984	31,190	34,174	11.0	14.6	14.2
Total	78,034	1,128,635	1,206,669	9.8	17.2	16.4

Adult anglers (those 16+) living in the Bonavista-Trinity area caught the most cod on average at 22 fish each. The total catch for these anglers accounted for almost 234,000 cod, or almost 21% of the total catch by adult anglers. Adult anglers living in the West NL-N. Peninsula had the lowest average harvest of just over 12 fish each. Their total catch of under 73,500 fish accounted for around 6.5% of the total cod harvest. Only adult anglers living in Labrador accounted for fewer fish being harvested in the 2007 recreational cod fishery, although anglers harvested almost 15 fish each.

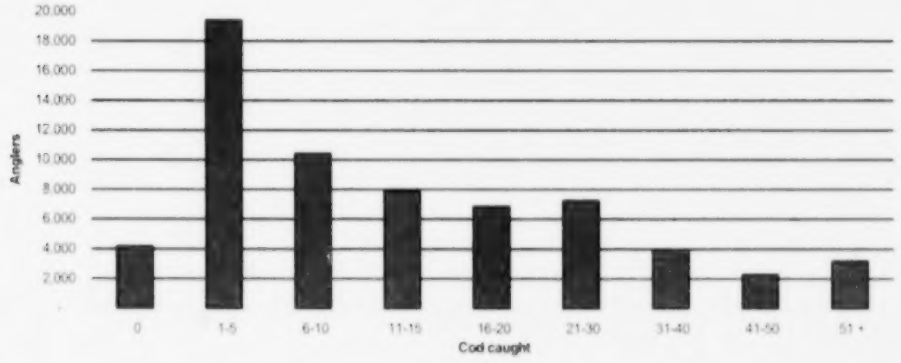
Over 60% of all cod caught was harvested from NAFO sub-division 3L, with an average of 18 fish caught by each angler fishing in this sub-division (Table 13). Anglers under 16 years of age caught about 49,600 cod in sub-division 3L, accounting for almost 64% of all cod harvested by younger anglers. The lowest number of cod caught in any NAFO sub-division was 11,555 fish, or an average of 10 per angler, in sub-division 2J. These fish represented less than 1% of the total number of cod harvested in the 2007 Newfoundland and Labrador recreational cod fishery.

It should be noted that the daily personal limit for cod in the 2007 recreational fishery was 5 fish. As indicated earlier, the total number of days the fishery was open was 35. In total, therefore, anglers could have taken 175 fish each. Given there were over 73,400 anglers who fished, the theoretical total harvest would have been about 12,845,000 cod. The harvest estimated from the survey represents less than 10% of the total theoretical harvest, demonstrating a responsible, tempered harvest for the 2007 recreational cod fishery.

Table 13 Number and average cod caught by age category, by NAFO sub-division of activity.

NAFO sub-division	Cod caught			Average cod caught		
	< 16	16 +	Total	< 16	16 +	Total
2J	593	10,962	11,555	5.5	10.5	10.0
3K	17,230	263,564	280,794	8.0	16.0	15.1
3L	49,649	677,164	726,813	10.9	18.8	17.9
3Pn	722	17,402	18,124	8.3	18.0	17.2
3Ps	5,378	102,211	107,589	9.0	17.4	16.6
4R	4,462	57,332	61,794	9.0	11.4	11.2
Total	78,034	1,128,635	1,206,669	9.8	17.2	16.4

Chart 4 Distribution of adult anglers by the number of cod caught.



As can be seen in Chart 4, over 19,000 adult anglers (29.6% of all anglers) caught between 1 and 5 fish each in 2007. About 3,200 adult anglers (< 5%) took more than 50 fish each. Although anglers could have taken 175 fish for the season, the maximum number of cod taken was 140 fish by an estimated 50 anglers. Again, activity by anglers demonstrated a responsible exploitation of the recreational cod fishery.

Anglers caught an average of 4 fish per day, or 1 less than the limit to which they were entitled (Table 14). Younger anglers averaged 3.4 fish each per day, with those living on the Avalon Peninsula taking the highest number of cod per day per angler at 3.9 fish each. The lowest number of cod taken per day by younger anglers was by those residing in the West NL-N. Peninsula area of the province (2.5 fish per day). Adult anglers living in the Bonavista-Trinity area took the most cod per day on average at 4.4 fish, while those living in the West NL-N. Peninsula area taking the lowest at 3.6 fish each per day.

Table 14 Average number of cod caught per day, by age category, by residence area.

Residence area	Cod catch per day		
	< 16	16 +	Total
Avalon Peninsula	3.9	4.0	4.0
Burin-South Coast	3.5	4.4	4.3
West NL- N. Peninsula	2.5	3.6	3.5
Central-NE Coast	3.1	3.9	3.9
Bonavista-Trinity	3.2	4.5	4.4
Labrador	3.6	4.1	4.0
Total	3.4	4.1	4.0

Younger anglers fishing in NAFO sub-division 2J harvested the fewest cod per day, reporting just 2 fish per day per angler (Table 15). In contrast, younger anglers fishing in NAFO sub-division 3L took almost 4 cod each per day fished. In the more heavily fished NAFO sub-divisions (3K, 3L), adult anglers caught around 4 fish each per day fished. Despite its relatively small area, adult anglers in 3Pn reported taking the highest number of cod per day each at 4.6 fish. Those adult anglers fishing in NAFO sub-division 4R harvested the lowest number of fish per day each (3.6 fish).

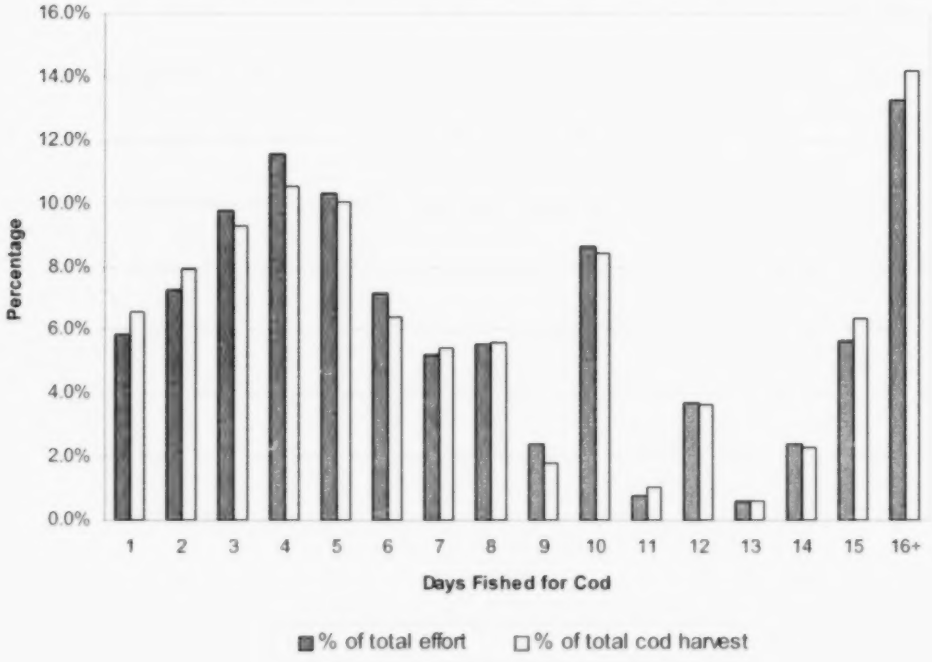
About 6% of adult anglers who fished caught no cod at all. Almost 50% of adult anglers who fished caught their limit of 5 fish per day fished. These adult anglers accounted for 47% of days fished and almost 58% of all cod harvested.

Table 15 Average number of cod caught per day, by age category, by NAFO sub-division of activity.

NAFO sub-division	Cod catch per day		
	< 16	16 +	Total
2J	2.0	4.0	3.8
3K	3.2	3.8	3.7
3L	3.7	4.2	4.1
3Pn	2.2	4.6	4.4
3Ps	3.3	4.4	4.3
4R	2.6	3.6	3.5
Total	3.4	4.1	4.0

Almost 52% of all cod harvested by adult anglers were taken by anglers fishing six days or less (Chart 5). These anglers accounted for over 50% of the total effort expended in 2007 fishing for cod in the recreational cod fishery of NL. Anglers who fished 20 days fished for a total of almost 37,000 days and caught a total of almost 135,000 cod (or just under 4 each per day)

Chart 5 Distribution of total effort and total cod harvest for adult anglers, by days fished for cod.



Based on the estimated total number of cod harvested (1.2 million), we can further estimate the approximate weight of cod caught in 2007. Using an average weight of cod of 2.02 kilograms as estimated by C&P, the weight of cod harvested in the recreational cod fishery was about 2,438 tonnes. Table 16 shows the number and the approximate weight of cod landed by NAFO sub-division.

Table 16 Estimated number and weight of cod caught, by NAFO sub-division of activity.

NAFO sub-division	Cod caught in 2007	
	Number	Weight (mt)
2J	11,555	23.3
3K	280,794	567.2
3L	726,813	1,468.2
3Pn	18,124	36.6
3Ps	107,589	217.3
4R	61,794	124.8
Total	1,206,669	2,437.5

Wolffish

Adult anglers who fished in the Newfoundland and Labrador recreational cod fishery in 2007 were asked if they had caught any wolffish. The purpose of this question was to establish the number of incidental wolffish interceptions that occurred in the 2007 recreational cod fishery. Under the Species at Risk Act, wolffish which are caught are to be safely returned to the water (if possible). In commercial fishing operations, wolffish that are intercepted without successful return to the water must be reported and the fisher issued with an incidental harm permit.

In the recreational fishery, an estimated 1,600 anglers reported catching wolffish during the course of their cod fishing activities. They reported that they caught a total of 3,601 wolffish, of which they returned all to the water successfully. It may be assumed that the rate of incidental harm in the recreational fishery is extremely low as a result of the findings in this survey.

APPENDIX A

Survey Methodology and Data Quality

This section outlines the full methodology used in the 2007 Survey of the Recreational Cod Fishery of Newfoundland and Labrador.

In the absence of a licence to fish for cod and, with it, any associated reporting mechanisms to follow up after the fishing season, a household survey of residents of Newfoundland and Labrador had to be undertaken. This was the only possible way of successfully assessing the numbers of anglers, the days fished, cod caught, etc. The procedures carried out to ensure a successful survey are discussed below.

The survey fieldwork was carried out by Bristol Omnifacts Research, a major research firm, located in St. John's, NL.

Sampling

As explained in the Survey Overview section, a random sample of households was interviewed in each of Statistics Canada's Census Divisions in the province (Divisions 10 and 11, which comprise Labrador were treated as a single Census Division). For the ease of reporting results from the survey, these Census Divisions were grouped into six specific geographic areas (see Figure 1).

Data Collection, Processing, Coding and Estimation

The survey was launched on October 18, 2007, within a week and a half of the closing date of the recreational cod fishing season. Press Releases and news items before and during the season included references to the post-season survey whenever possible, so anglers in the province were fully aware that the survey would be undertaken. The survey was conducted by telephone, with the interview lasting between three minutes for households in which no one had fished recreationally for cod and five minutes if anglers in the household had participated in the 2007 recreational cod fishery.

While most coding was provided on the documents, answers relating to where anglers had fished for cod were post-coded into bays and coastal areas, based on responses provided by respondents. Many bays around the province carry the same name, despite being located in diverse areas. Hence, for post-coded bays, entries had to be assessed to ensure that the specific bay identified was the most likely area fished by respondents. A combination of the bay name and the telephone number prefix of the respondent were used in combination to determine cases where there might have been miscoding based on bay name alone. Only a few number of responses had to be corrected, based on an unlikely location for fishing activity when compared to the residence location. In all instances, a bay with the same name was located near the residence location. For example, there are three bays called Bonne Bay: one on the west coast, one on the south coast and a third at the tip of the Northern Peninsula. The Bonne Bay referred to in the post-coded bays was the one on the west coast of the province. While possible, it was considered highly unlikely that an angler living in the Burin or Hermitage Districts would be fishing for cod on the west coast of the province.

A major requirement in the editing and coding phase was verification that the information provided by anglers was both reasonable and sound for the numbers of anglers in the household and for the information related to the recreational cod fishery. This included assessing the number of fish caught, the number of cod caught compared to days fished, the number of

individuals in the household, males and females in the household balancing with total numbers of individuals, etc. There were no responses that were changed due to unexpected or unreasonable data provided during the interviews. As well, no responses were deemed suspect as being out of scope for the fishery. For example, the total number of days the fishery was open was 35, but the maximum number of days fished was reported at 20. Similarly, anglers could have harvested a maximum of 175 cod during the season and no angler reported exceeding this number. It should be noted that in those instances where anglers reported more than 5 fish per day being harvested, no attempt was made to "make the catch legal" (i.e., 5 fish). These responses were accepted at face value in light of the assurances anglers were given guaranteeing anonymity in the survey.

The required programming to produce survey estimates consisted of:

- systematic editing procedures;
- substitution algorithms for missing data (only age in this survey);
- data output programs covering all data collected; and
- special output programs for publication purposes.

Weighting Procedures

Weighted estimates were produced to ensure that the raw survey data reflected estimates for the population of Newfoundland and Labrador. The multi-step process for weighting the results of the survey is as follows:

- as shown in Table A.1, calculate household weights for the 10 Census Divisions used in the survey by dividing the number of households reported for each Census Division by the number of households in the sample

Table A.1 Household weights developed for the 2007 Survey of the Recreational Cod Fishery in NL

Census Divisions	Number of households	Households sampled	Household weight
Division 1 - Avalon Peninsula	97,015	1,409	68.8538
Division 2 - Burin	8,710	404	21.5594
Division 3 - South Coast	6,895	405	17.0247
Division 4 - Southwest	8,720	401	21.7456
Division 5 - West Central	15,925	405	39.3210
Division 6 - Central	14,230	405	35.1358
Division 7 - Bonavista	14,010	407	34.4226
Division 8 - Northeast Coast	15,440	409	37.7506
Division 9 - Northern Peninsula	6,995	406	17.2291
Division 10 - Labrador	9,240	404	22.8713
Total	197,180	5,055	--

Source: Statistics Canada

- the household weights were applied to the information collected on individuals during the interviews

- the estimated numbers of males and females, under 16 years of age, in total and the number who fished as well as the number of males and females over 16 years of age, in total and the number who fished, were calculated
- the total number of males and females were compared to the estimated population information provided by Statistics Canada from the 2006 Census of Canada, with the purpose of adjusting the estimated numbers of anglers, based on the rates of activity found in each group in each Census Division (Table A.2)

Table A.2 Initial estimates of population and angler numbers, for males and females 16+, by Census Division

Census Divisions	Males 16+			Females 16+		
	Total	Anglers	Rate	Total	Anglers	Rate
No. 1	106,448	18,591	17.5%	89,235	8,194	9.2%
No. 2	9,184	1,509	16.4%	8,387	604	7.2%
No. 3	7,389	1,890	25.6%	6,555	749	11.4%
No. 4	8,785	913	10.4%	7,850	174	2.2%
No. 5	16,593	1,691	10.2%	14,706	668	4.5%
No. 6	14,933	3,057	20.5%	13,422	1,616	12.0%
No. 7	14,217	6,609	46.5%	12,943	3,167	24.5%
No. 8	16,271	6,116	37.6%	14,421	3,096	21.5%
No. 9	7,529	1,654	22.0%	6,513	603	9.3%
No. 10	9,858	1,327	13.5%	8,508	778	9.1%
Total	211,206	43,356	20.5%	182,538	19,648	10.8%

Source: Statistics Canada.

- the numbers of males and females 16 years of age and over who fished were then adjusted for each Census Division to ensure that the total number of males and females 16 years of age and over matched Census data (Table A.3)

Table A.3 Census population and final adjusted angler numbers, for males and females 16+, by Census Division

Census Divisions	Males 16+			Females 16+		
	Total	Anglers	Rate	Total	Anglers	Rate
No. 1	98,577	17,216	17.5%	108,661	9,977	9.2%
No. 2	9,162	1,506	16.4%	9,574	689	7.2%
No. 3	7,318	1,872	25.6%	7,720	882	11.4%
No. 4	8,589	893	10.4%	9,162	203	2.2%
No. 5	16,294	1,660	10.2%	17,851	811	4.5%
No. 6	14,329	2,933	20.5%	15,842	1,908	12.0%
No. 7	14,595	6,785	46.5%	15,586	3,814	24.5%
No. 8	16,389	6,160	37.6%	16,842	3,615	21.5%
No. 9	7,554	1,659	22.0%	7,871	729	9.3%
No. 10	9,509	1,280	13.5%	9,307	851	9.1%
Total	202,316	41,964	20.5%	218,416	23,479	10.8%

- a similar approach for population and anglers under 16 years of age was completed
- for anglers 16 years of age and over, respondent weights were calculated in order to develop population estimates for their angling activity (Table A.4)

Table A.4 Respondent weights developed for male and female anglers 16+, by Census Division

Census Divisions	Males 16+			Females 16+		
	Sample	Anglers	Weight	Sample	Anglers	Weight
No. 1	199	17,216	86.51	64	9,977	155.90
No. 2	55	1,506	27.37	16	689	43.07
No. 3	88	1,872	21.27	27	882	32.68
No. 4	39	893	22.90	4	203	50.76
No. 5	33	1,660	50.31	15	811	54.10
No. 6	61	2,933	48.08	23	1,908	82.94
No. 7	139	6,785	48.81	45	3,814	84.75
No. 8	114	6,160	54.04	48	3,615	75.32
No. 9	60	1,659	27.66	24	729	30.37
No. 10	45	1,280	28.44	17	851	50.04
Total	833	41,964	--	283	23,479	--

- the above weights were used to produce population estimates of effort and harvest in the 2007 recreational cod fishery as well as estimates of wolffish interceptions in the fishery
- a slightly different approach for anglers under 16 years of age was required since the information calculated using household weights resulted in total numbers of males and females. This required that estimates of effort and harvest in the 2007 recreational cod fishery be derived by calculating days fished per angler and fish caught per angler by sex and then applying these averages to the estimated number of male and female anglers under 16 years of age

  Explanation:

  In Census Division 1, the original estimates for males under 16 years of age were:

  24,944 males, with 2,341 fishing 8,262 days and catching 35,322 cod

  However, from Census data, we know that the number of males under 16 years of age in Census Division 1 was 21,651, thereby requiring that the number of anglers be reduced to 2,028. From the original estimates for these anglers, they fished about 3.5 days each and caught 15.1 cod each. Hence, for this Census Division, the estimates of days fished and cod caught by males under 16 years of age were calculated as 7,158 days and 30,598 cod, respectively.

  Tables A.5a/b on page 20 and Tables A.6a/b on page 21 provide detailed estimates and adjustments for male and female anglers under 16 years of age.

No adjustments were made to reflect the minor change of approximately 1,000 individuals in the population of Newfoundland in 2007.

A.5a Initial Estimates for Males Under 16 Years of Age

Census Division	Initial Estimates					
	Total	Anglers	Days fished	Average	Cod caught	Average
Division No. 1	24,994	2,341	8,262	3.5	35,322	15.1
Division No. 2	1,897	65	604	9.3	2,587	40.0
Division No. 3	1,379	187	528	2.8	1,328	7.1
Division No. 4	1,718	65	130	2.0	261	4.0
Division No. 5	3,932	393	1,612	4.1	3,146	8.0
Division No. 6	3,970	457	1,405	3.1	2,987	6.5
Division No. 7	2,685	688	1,859	2.7	6,471	9.4
Division No. 8	2,756	793	2,265	2.9	9,060	11.4
Division No. 9	1,344	121	310	2.6	1,189	9.9
Division No. 10	2,882	206	778	3.8	2,790	13.6
Total	47,557	5,316	17,754		65,141	

A.5b Adjusted Estimates for Males Under 16 Years of Age

Census Division	Adjusted Estimates			
	Total*	Anglers**	Days fished***	Cod caught***
Division No. 1	21,651	2,028	7,158	30,598
Division No. 2	1,885	64	600	2,570
Division No. 3	1,407	191	539	1,355
Division No. 4	1,890	72	144	287
Division No. 5	3,453	345	1,416	2,762
Division No. 6	3,186	367	1,128	2,397
Division No. 7	2,885	740	1,997	6,953
Division No. 8	3,016	867	2,479	9,914
Division No. 9	1,347	121	311	1,192
Division No. 10	2,699	193	728	2,613
Total	43,419	4,988	16,498	60,642

*** based on the 2006 Census of Canada**

**** proportional allocation based on initial estimates**

***** based on averages found in initial estimates**

The adjusted estimates found above were used to allocate activity and harvest to residence areas and to NAFO areas of effort and catch for male anglers under 16 years of age.

A.6a Initial Estimates for Females Under 16 Years of Age

Census Division	Initial Estimates					
	Total	Anglers	Days fished	Average	Cod caught	Average
Division No. 1	23,135	1,584	2,754	1.7	8,056	5.1
Division No. 2	2,005	65	388	6.0	1,509	23.3
Division No. 3	1,515	136	204	1.5	630	4.6
Division No. 4	1,914	22	22	1.0	43	2.0
Division No. 5	3,539	79	157	2.0	393	5.0
Division No. 6	3,057	246	492	2.0	1,335	5.4
Division No. 7	3,270	516	1,308	2.5	3,614	7.0
Division No. 8	3,511	566	1,359	2.4	2,794	4.9
Division No. 9	1,775	138	310	2.3	1,292	9.4
Division No. 10	2,673	91	114	1.3	435	4.8
Total	46,693	3,443	7,109		20,101	

A.6b Adjusted Estimates for Females Under 16 Years of Age

Census Division	Adjusted Estimates			
	Total*	Anglers**	Days fished***	Cod caught***
Division No. 1	20,735	1,419	2,468	7,220
Division No. 2	1,788	58	346	1,346
Division No. 3	1,321	119	178	549
Division No. 4	1,658	19	19	38
Division No. 5	3,401	76	151	378
Division No. 6	3,024	243	487	1,321
Division No. 7	2,607	412	1,043	2,881
Division No. 8	2,878	464	1,114	2,290
Division No. 9	1,371	107	240	998
Division No. 10	2,537	78	98	371
Total	41,319	2,994	6,143	17,392

*** based on the 2006 Census of Canada**

**** proportional allocation based on initial estimates**

***** based on averages found in initial estimates**

As was done for under-age male anglers, the adjusted estimates found above were used to allocate activity and harvest to residence areas and to NAFO areas of effort and catch for female anglers under 16 years of age.

Data Quality

Sampling Error

Information on reliability is presented in terms of the coefficient of variation of the mean, at one standard deviation. Because exact estimates of variance cannot be calculated, the coefficient of variation of the mean is used as a proxy for the assessing the variability of the data. Table A.7 presents the statistical reliability of key variables for various presentations of the data.

The ranges of coefficient of variation (c.v.) below provide guidelines as to the use of the data:

Coefficient of variation	Guideline
less than 16.5%	Data can be used without condition
16.5% to 33.5%	Data should be used with caution
greater than 33.5%	Data should be used with extreme caution

Source: Statistics Canada.

Table A.7 Coefficient of variation (in %) for selected key variables for anglers aged 16 years of age and older

	Days fished	Cod caught
Residence Area		
Avalon	6.3	6.9
Burin-South Coast	6.9	8.1
West NL- N. Peninsula	6.5	8.6
Central-NE Coast	6.1	6.8
Bonavista-Trinity	6.3	7.5
Labrador	13.4	15.1
Locations Fished		
2J	19.1	18.5
3K	5.5	5.9
3L	4.5	5.3
3Pn	17.0	18.1
3Ps	7.2	8.6
4R	7.3	9.1
Total	2.9	3.3

Non-Sampling Error

During the data collection phase, efforts were made to reduce the occurrence of non-sampling errors in the survey. These efforts included a complete verification of the reported data, validity and consistency edits.

One source of non-sampling error that is not considered to play a significant role in this survey is errors introduced due to recall issues related to effort or catch. The time between fishing activity and the survey was no more than three months, limiting any short-term recall regarding the angling activity in 2007.

Data Limitations

Despite all efforts to improve data accuracy, the survey results have limitations. Understanding these limitations will help the reader make informed decisions before conducting further research and analysis using the estimates in this report:

1. Estimates of cod fishing effort and harvest reported for age groups by either residence area or by areas fished will have reduced reliability

2. Data tables presented by bay or coastal area are for information purposes only as the survey was not designed to produce data at this level. Reliability levels are presented in Table A.8.

Table A.8 Coefficient of variation (in %) for selected key variables for anglers aged 16 years of age and older

Bay/Coastal Area	Days	Cod
Trinity Bay	7.1	7.8
Notre Dame Bay	7.7	7.9
Bonavista Bay	7.8	9.6
Conception Bay	9.1	12.8
Placentia Bay	10.7	16.6
St. George's Bay	10.8	21.3
Green Bay	12.0	12.8
White Bay	12.9	15.5
Fortune Bay	13.0	14.8
South Coast	14.9	15.8
Bay of Islands	15.2	20.0
Baie d'Espoir	16.1	17.0
Northern Peninsula 4R	16.2	18.0
Eastern Avalon	16.4	16.9
S&E of Port aux Basques	17.0	18.1
Bonne Bay	18.5	30.8
Labrador Coast	19.1	18.5
Port au Port Bay	19.4	22.4
Bay of Exploits	19.9	22.0
Strait of Belle Isle	20.0	21.8
Hare Bay	23.5	27.8
Hermitage Bay	25.9	26.3
Northern Peninsula 3K	28.7	33.5
W&N of Port aux Basques	29.8	23.8
St. Mary's Bay	53.5	45.0

Data comparability

The 2007 survey results are relatively comparable with the results for cod fishing by residents of Newfoundland and Labrador from the 2000 Survey of Recreational Fishing in Canada (SRF) and the 2001 Log Book Recall Assessment for Newfoundland and Labrador. Although not directly comparable, data on cod fishing in NAFO sub-division 3Ps in 2005, from the 2005 Survey of Recreational Fishing in Canada, and the 2007 results are reasonably close. These comparisons are provided in Table A.9 below.

Table A.9 Comparison of cod fishing information from previous surveys to the results of the 2007 survey (with age coverage noted)

Source	Catch	Weight**	3Ps
		mt	#
2000 SRF – anglers 18+	1,013,428	2,432.2	--
2001 Logbook – anglers 16+	1,166,667*	2,800.0	--
2005 SRF (3Ps only) – anglers 18+	--	--	94,299
2007 Survey – 16+	1,128,635	2,279.8	102,211

* Number of fish harvested is based on an average weight of 2.4 kilograms divided into the total weight estimate derived in 2001. Information on the specific number of cod caught was not available.

** total weight was calculated using an average weight of 2.4 kilograms per cod in 2000 and a weight of 2.02 kilograms per cod in 2007.

APPENDIX B

NEWFOUNDLAND AND LABRADOR
2007 SURVEY OF THE RECREATIONAL COD FISHERY

Hello, my name is _____ of **Bristol Omnifacts Research** and I am calling on behalf of the Department of Fisheries and Oceans. May I speak with a member of this household who is **16** years of age or older? Our company has been hired by the Department of Fisheries and Oceans to help them determine the number of people who fished in the recreational cod fishery in the province in 2007. Even if no one in your household participated in the recreational cod fishery in 2007, we need to obtain some very basic household information in order to complete this study. The questions I have will take between 2 and 5 minutes of your time.

Please note that this survey is completely anonymous. Only the information requested during this telephone session will be maintained in electronic form and only for analysis purposes.

Would you be willing to help on this study?

Yes (1) (if YES, continue)

No (2) (if NO, end interview and thank individual) (Refused=97).

PART 1: HOUSEHOLD AND FISHING ACTIVITY – CHILDREN UNDER 16

The first part of this survey deals with questions about those in your household **under** the age of **16.**

1a). How many people **under** the age of 16 live in your household?

_____ (if "0", go to QUESTION 2) (Refused=97)

1b). How many of these people are male? _____ (if "0",**Continue**) (Refused=97)

1c). Just to confirm, there is/are <RECALL 1A-1B> female(s) under the age of 16 in your household? _____ (if "0", go to QUESTION 2) (Refused=97)

1d). [PN: IF 1B=1, READ: Did the male under 16 fish in the recreational cod fishery in the province in 2007?; PN IF 1B>1 READ: How many of the <RECALL FROM 1B> males under 16 fished in the recreational cod fishery in the province in 2007?

_____ (if "0", go to Part 1**h**) (Refused=97)

1e). As best as you can estimate, how many days in total did they/he fish for cod? [Interviewer note: for Q1e to Q1g, they=MALES UNDER 16 in the household]

Cod days _____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW)

1f). How many cod in total did they/he harvest in the province in 2007?

Cod harvested _____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW)

1g). Where did most of the activity and harvest occur? (bay, town or coastal area):

_____ Bay (___) Town (___) Coastal (___)
(Refused=97/ Don't know=98)

1h). **[PN: IF 1c=1, READ:** Did the female under 16 fish in the recreational cod fishery in the province in 2007?; **PN IF 1c>1 READ**: How many of the <**RECALL 1c**> females under 16 fished in the recreational cod fishery in the province in 2007?

_____ (if "0", go to QUESTION 2) (Refused=97/Don't know=98)

1i). As best as you can estimate, how many days in total did they/she fish for cod? [Interviewer note: for Q1i to Q1k, they=FEMALES UNDER 16 in the household]

Cod days _____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW)

1j). How many cod in total did they/she harvest in the province in 2007?

Cod harvested _____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW)

1k). Where did most of the activity and harvest occur (bay, town or coastal area):

_____ Bay (___) Town (___) Coastal (___)
(Refused=97/Don't Know=98)

PART 2: HOUSEHOLD AND FISHING ACTIVITY – ADULTS 16 YEARS AND OLDER

Now we'd like you to think about those 16 years of age or older in your household.

2a). Including yourself, how many people 16 years of age or older live in your household?

_____ (Refused=97)

2b). How many of these people are male? _____ (if "0", go to Part 2d) (Refused=97)

2c). How many of these **males** fished in the recreational cod fishery in the province in 2007?

_____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW)

2d). Just to confirm, there are <**RECALL 2a-2b**>____ females 16 years of age or older in the household? (if "0", go to QUESTION 3) (Refused=97)

2e). How many of these **females** fished in the recreational cod fishery in the province in 2007? _____ (IF Refused=97/Don't Know=98, TERMINATE INTERVIEW

[IF NO ONE IN THE HOUSEHOLD 16 YEARS OF AGE OR OLDER FISHED IN THE RECREATIONAL COD FISHERY IN NEWFOUNDLAND AND LABRADOR IN 2007, RECORD GENDER, THANK THE INDIVIDUAL FOR THEIR COOPERATION]

[IF ANYONE 16 YEARS OF AGE OR OLDER AND FISHED FOR RECREATION, COMPLETE THE NEXT SERIES OF QUESTIONS]

PART 3: FISHING ACTIVITY – RANDOMLY SELECTED ADULT FISHER 16 YEARS AND OLDER

[SELECT APPROPRIATE RESPONDENT BASED ON NEXT BIRTHDAY]

For the remaining section of this survey, I am required to speak with a person in your household **16 years of age or older** who fished in the recreational cod fishery in the province in 2007. If there is more than one person in your household matching this description, I will need to speak with the person who will next celebrate their birthday. Would that be you or someone else?

S1 **INTERVIEWER RECORD:** Person on the phone is the person who fished AND whose birthday comes next.

Correct person on the phone	**GO TO Q3**
Someone else	**CONTINUE**

S2. Who would that be? **RECORD NAME** _____

S3. Is <RECALL NAME> available now?

Yes	**CONTINUE**
No	**SET CALL BACK TIME**

[IF DIFFERENT PERSON COMES TO THE PHONE, RE-INTRODUCE YOURSELF AND THE TOPIC OF THE STUDY]

3. How many days did you personally fish for cod in the recreational cod fishery in the province in 2007?

Days fished _____ days (IF Refused=97/Don't know=98, TERMINATE INTERVIEW)

4. How many cod did you personally harvest during the recreational cod fishery in the province in 2007?

Cod harvested _____ cod (IF Refused=97/Don't know=98, TERMINATE INTERVIEW)

5. As near as you can remember, in which bay or near which town or on which coastal area of the province did you harvest most of your cod in the recreational cod fishery in the province in 2007?

_____ Bay (___) Town (___) Coastal (___)
(Refused=97)

6a. During your days fishing for cod did you personally harvest any **wolffish** during the recreational cod fishery in the province in 2007?

Yes ___ No ___ Don't know ___

6b. If yes, how many **wolffish** did you catch and how many did you successfully release back into the water during the recreational cod fishery in the province in 2007?

Number of wolffish _____ Number of wolffish released _____

Now, we have just one final question to help us categorize responses.

7. In what year were you born? 19____ **IF REFUSED, ASK FOR CATEGORY**

1 16 - 24 2 25 - 34 3 35 - 44 4 45 - 54 5 55 - 64
6 65 or older 7 Refused

INTERVIEWER RECORD: Respondent's sex? Male ____ Female ____

THANK THE RESPONDENT FOR THEIR TIME AND FOR THE INFORMATION THEY HAVE PROVIDED. RESULTS FROM THE SURVEY WILL BE REPORTED BY DFO ON ITS WEBSITE IN EARLY 2008

Interviewer's Name:_____ Month: _____ Day ____

Phone Number:_____ Region:_____

CODE ASSIGNMENT: (Census Region and Respondent Number): __ _____

APPENDIX C

SUPPLEMENTARY TABLES – FOR INFORMATION PURPOSES ONLY

Table C.1 Number of days fished for cod, by Bay/Coastal area, by residence area, anglers 16 years of age and older

Bay/Coastal area	Residence area						Total
	Avalon	Burin-South Coast	West NL-N. Peninsula	Central-NE Coast	Bonavista-Trinity	Labrador	
Trinity Bay	47,037	286	23	839	24,187	242	72,615
Notre Dame Bay	5,282	43	398	36,656	732	85	43,196
Bonavista Bay	3,705	208	243	2,823	26,970	711	34,660
Conception Bay	26,998	-	254	2,576	134	271	30,232
Eastern Avalon	22,102	246	28	-	-	-	22,376
Fortune Bay	865	7,763	-	703	-	-	9,331
Placentia Bay	5,192	3,869	151	-	-	-	9,213
Green Bay	-	-	108	8,450	-	285	8,844
White Bay	-	21	3,213	3,623	-	85	6,942
Bay of Exploits	260	-	595	5,945	98	28	6,926
Strait of Belle Isle	-	21	617	299	-	3,236	4,173
Bay of Islands	156	-	3,814	-	-	85	4,056
S&E of Port aux Basques	519	3,258	-	-	-	-	3,777
Labrador Coast	-	-	46	54	-	2,671	2,770
Northern Peninsula 4R	-	170	2,437	-	-	-	2,607
South Coast	87	2,298	23	-	-	-	2,407
St. Mary's Bay	2,232	-	-	-	-	-	2,232
Hare Bay	-	-	1,726	337	-	-	2,062
Northern Peninsula 3K	156	-	1,807	-	-	-	1,962
St. George's Bay	-	-	1,891	-	-	-	1,891
Bonne Bay	-	-	1,708	-	-	-	1,708
Hermitage Bay	-	1,098	-	324	-	-	1,422
Port au Port Bay	87	-	842	-	-	-	929
Baie d'Espoir	-	779	-	-	-	-	779
W&N of Port aux Basques	-	276	214	-	-	-	490
Total	114,677	20,335	20,137	62,629	52,121	7,709	277,599

Table C.2 Number of cod caught, by Bay/Coastal area, by residence area, anglers 16 years of age and older

Bay/Coastal area	Residence area						Total
	Avalon	Burin-South Coast	West NL-N. Peninsula	Central-NE Coast	Bonavista-Trinity	Labrador	
Trinity Bay	200,830	395	114	3,501	102,643	677	308,160
Notre Dame Bay	14,718	128	1,738	140,561	3,417	284	160,846
Bonavista Bay	11,045	1,528	564	14,170	126,439	3,981	157,726
Conception Bay	97,603	-	761	13,455	814	953	113,587
Eastern Avalon	93,224	1,040	138	-	-	-	94,402
Placentia Bay	22,968	21,895	302	-	-	-	45,165
Fortune Bay	4,066	28,999	-	3,515	-	-	36,580
Green Bay	-	-	270	32,481	-	811	33,562
White Bay	-	106	12,094	15,645	-	142	27,987
Bay of Exploits	2,163	-	649	20,232	342	284	23,670
S&E of Port aux Basques	2,595	14,807	-	-	-	-	17,402
Strait of Belle Isle	-	106	2,154	1,081	-	13,253	16,594
Bay of Islands	779	-	11,818	-	-	341	12,939
South Coast	433	10,965	114	-	-	-	11,512
Northern Peninsula 4R	-	851	10,600	-	-	-	11,450
Labrador Coast	-	-	229	270	-	10,463	10,962
Hare Bay	-	-	7,936	962	-	-	8,898
Northern Peninsula 3K	-	-	8,599	-	-	-	8,599
St. George's Bay	-	-	6,795	-	-	-	6,795
Hermitage Bay	-	5,292	-	1,081	-	-	6,373
Port au Port Bay	-	-	3,867	-	-	-	3,867
Bonne Bay	-	-	3,729	-	-	-	3,729
St. Mary's Bay	3,287	-	-	-	-	-	3,287
Baie d'Espoir	-	2,581	-	-	-	-	2,581
W&N of Port aux Basques	-	936	1,022	-	-	-	1,958
Total	453,712	89,630	73,495	246,953	233,655	31,190	1,128,635

Table C.3 Cod fishing activity, by NAFO sub-division, by residence area, anglers 16 years of age and older

NAFO Sub-Division	Residence area						Total
	Avalon	Burin-South Coast	West NL-N. Peninsula	Central-NE Coast	Bonavista-Trinity	Labrador	
2J							
Days fished	-	-	46	54	-	2,671	2,770
- average	-	-	2.0	1.0	-	2.8	2.6
Cod caught	-	-	229	270	-	10,463	10,962
- average	-	-	10.0	5.0	-	10.8	10.5
Anglers	-	-	23	54	-	969	1,046
3K							
Days fished	5,697	64	7,847	55,011	830	485	69,933
- average	4.6	1.0	4.4	4.2	3.4	2.5	4.2
Cod caught	16,880	234	31,288	209,881	3,759	1,522	263,564
- average	13.7	3.7	17.4	16.2	15.4	7.9	16.0
Anglers	1,229	64	1,801	12,966	244	192	16,495
3L							
Days fished	102,074	740	548	6,238	51,291	1,224	162,115
- average	4.3	4.7	3.1	5.0	5.0	4.1	4.5
Cod caught	405,990	2,963	1,578	31,125	229,896	5,611	677,164
- average	17.1	18.8	8.9	24.8	22.2	18.8	18.8
Anglers	23,766	158	177	1,256	10,355	299	36,011
3Pn							
Days fished	519	3,258	-	-	-	-	3,777
- average	6.0	3.7	-	-	-	-	3.9
Cod caught	2,595	14,807	-	-	-	-	17,402
- average	29.8	16.9	-	-	-	-	18.0
Anglers	87	878	-	-	-	-	965
3Ps							
Days fished	6,144	15,806	174	1,027	-	-	23,151
- average	3.3	4.2	2.4	5.0	-	-	3.9
Cod caught	27,467	69,733	416	4,596	-	-	102,211
- average	14.7	18.6	5.7	22.5	-	-	17.4
Anglers	1,869	3,742	73	204	-	-	5,889
4R							
Days fished	242	468	11,523	299	.	3,321	15,853
- average	1.0	4.4	3.0	2.2	-	5.0	3.1
Cod caught	779	1,893	39,984	1,081	.	13,594	57,332
- average	3.2	17.9	10.3	7.9	-	20.3	11.4
Anglers	242	106	3,882	137	-	670	5,037

Fisheries and Oceans Canada

Five-Year Research Agenda (2007-2012)

Canada

Fisheries and Oceans Canada

Five-Year Research Agenda (2007-2012)

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1. Preamble

The focus of this document is **research**, one of the five key functions of the Science program. The other Science functions are: **monitoring; data management; scientific advice;** and **products and services**. All these functions, or components, are critical in their own right but they are all inter-connected. This document is not a "DFO Science Plan" as it does not try to capture all DFO scientific activities and programs and how they relate to each other.
The purpose of this **living** document is to outline an agenda to guide DFO's **research** program through the next five years. It details the background and drivers that led to the development of the agenda and highlights the need for a multidisciplinary and collaborative approach.
This agenda is comprehensive, but it should be noted that DFO and Government priorities evolve over time. DFO Science does not have the capacity and the expertise to address all components of each priority area within a five year period. **Choices will have to be made with a view of maximizing flexibility, integrating our work and developing collaborations with research partners**. With this in mind, this research agenda, the first of its kind for DFO, provides strategic direction on how effort and resources will be focused to ensure their alignment with federal and departmental priorities. Furthermore, **it will be the basis for the development of a detailed research plan.**

One might question where stock assessment fits in the research agenda. DFO Science is committed to maintaining a comprehensive stock assessment program and seizing all opportunities to support its continuing evolution within an ecosystem approach. Stock assessment requires a comprehensive set of activities such as long-term monitoring of species and their environment, analysis of commercial and research data, and the provision of scientific advice. Stock assessment also requires research to better support the management of the fisheries resources and this research plan will strongly contribute to the development of new knowledge that will be incorporated into future assessments.

A working group of DFO scientists from coast-to-coast-to-coast contributed to the development of the research priorities included in this research agenda.

2. Context

2.1 Fisheries and Oceans Science Program

Fisheries and Oceans Canada (DFO) has one of the most complex and comprehensive Science programs in the federal government, both in terms of function and geography. **It supports fisheries, aquaculture, oceans, and habitat management and maritime safety (client sectors) objectives and includes marine and freshwater environments and species.**
In spite of the increasingly integrated nature of departmental knowledge needs, client sectors require science advice and support that reflects their specific needs. They have come to rely on the traditional single-activity approach and are demanding increasingly specialised products and services. This need for integration, combined with increased demands for new types of knowledge and limited resources, is challenging the Science program's capacity to effectively support departmental and federal priorities.

In 2004, DFO began a comprehensive review of its Science Program to assess how it fit with new departmental strategic objectives and priorities and to identify specific changes required to better support DFO policy and decision-making. The Review recommended that the DFO Science Program realign its activities to:

- meet the needs of the Department, the federal government, and Canadians;
- reflect modern delivery mechanisms; and
- be effective, affordable, and sustainable for the long-term.

2.2 Science Renewal's Framework for the Future

In 2005, Science Renewal was launched to implement the recommendations of Science Review. Science Renewal identified the key changes necessary for achieving a more transparent, integrated, and effective Science Program including: ensuring Science activities are aligned with federal and departmental priorities; employing modern governance and accountability practices; implementing national funding decisions; and formalising Strategic and Business Planning practices.

Science Renewal's Framework for the Future aims at creating a vibrant aquatic science program based on excellence that supports and informs DFO and Government needs and best serves Canadians. The Framework outlines a renewed and realigned DFO Science Program that is **relevant, effective, affordable,** and **valued**. It also incorporates the three national science themes that support DFO's strategic outcomes:

1. understanding and describing the state of aquatic ecosystems
2. assessing and mitigating the impacts of human activities
3. supporting maritime safety, security, and sovereignty

2.3 A Balanced Science Program

Modern and effective delivery of science activities is achieved through a balanced Science program that is characterised by:

- Building long-term stability required to support decision and policy making by maintaining:
  1. An integrated **monitoring** program focusing on aquatic ecosystems; and
  2. A comprehensive scientific **data management** program.
- Maximising flexibility to respond to the evolving departmental and government-wide priorities by:
  1. Carrying out an integrated **research** program aligned with priorities;
  2. Providing timely and sound **scientific advice** supporting decision and policy making; and
  3. Developing **products and services** for the Public Good.

These five science functions, or components, are critical in their own right but they are all inter-connected. For instance, progress in research supports advances in science advice; new knowledge brings refinements to the monitoring program; high quality databases support the development of advice and services needed for decision and policy making.
Each science function is the subject of a planning process designed to capture the issues and challenges. It is in this context that:

- operational plans for monitoring are being developed for the Atlantic, the Pacific, the Arctic, Freshwater and Pacific salmon;
- a data & information management plan was recently completed and its recommendations are being implemented;

- a new science advice process has been implemented;
- a products & services operational plan is being developed; and
- a Five-Year Research Agenda (the subject of this document) has been developed.

These provide the foundation for generating and developing new knowledge bases or improving the applications of existing information.

3. Drivers and Priorities for Aquatic Research

Research is one of the essential components of a modern and cost-effective science program. As such, it is critical to develop a plan that focuses the **research** needed to ensure DFO Science has the necessary knowledge to support the Department's strategic objectives and priorities.

Aligning DFO's research agenda with established and forward-looking Departmental and government-wide priorities and issues of importance to Canadians is essential if our research and knowledge is to be both relevant and timely. In setting DFO's research priorities, a wide variety of documents was considered, including:

- DFO "2005-2010 Strategic Plan: Ours Waters, Our Future"
- DFO Transformational Plan (2005)
- Major Government priorities such as Climate Change, the North and Biodiversity
- DFO Ecosystem Science Framework in support of Integrated Management (2006)
- Report of the DFO "Aquatic Science 2020" workshop (2003)
- Report of the Science-Based Departments and Agencies "Beyond the Horizon; Identifying Emerging Priorities for S&T Integration" workshop (2005)

These documents clarify the priority issues, drivers, and challenges that may affect our research agenda and help identify the significant new knowledge required to inform policies, regulations, standards, and decisions.

3.1 Strategic Directions - Science Management Board

Obtaining clear strategic direction is essential to fine-tuning the alignment of a research agenda. By establishing its Science Management Board (SMB) in 2005, DFO took a major step toward this objective. **The SMB identifies science-related issues of importance to achieving DFO mandated objectives; establishes priorities in need of science support; and provides strategic direction on work planning for DFO Science**.

In October 2005, the SMB indicated that its two highest priorities for DFO Science were:

- A Science program that supports ecosystem-based management.
- A renewed Science workforce in light of changing demands and attrition.

The SMB also directed Science to develop a five-year research plan that supports the strategic agenda of the department and the government of Canada.
This led to the development of the **Ecosystem Science Framework** (completed), a **Science Human Resource Strategy** (in progress) and this **Five-Year Research Agenda**.

3.2 Ecosystem Science Framework

Aquatic ecosystems are increasingly affected by human activities. Limiting possible impacts and making human activities more sustainable is the complex task of policy-makers and managers who, in turn, rely on scientists for advice on which to base their decisions.

Ecosystem science is the foundation for the science needed to support the integrated management of diverse human activities such as fishing, aquaculture, transportation, and oil & gas exploration that are regularly undertaken in the same area. Ecosystem science provides decision-makers managing fisheries, aquaculture, habitat, and oceans resources and the recovery of species-at-risk essential advice on how these activities interact with each other and affect aquatic ecosystems. Ecosystem science is needed to inform the Department's policies and management practices and determine the necessary features of our Science activities.

An ecosystem science approach also means changing the way DFO provides science support. Scientists have to provide decision-makers with comprehensive ecosystem advice about how human activities may interact with other activities being undertaken in the same aquatic ecosystem or take adequate account of major environmental drivers in the ecosystem. **Implementing this new approach is far more than redistributing limited resources, it requires a philosophical and cultural shift and a change in the make up of the Science Program workforce**. These important issues are being addressed in the Science Human Resources strategy currently under development.

In response to the SMB, DFO Science developed the "New Ecosystem Science Framework in Support of Integrated Management". It provides a cost-effective and comprehensive approach for identifying, monitoring, and interpreting trends important to an ecosystem's sustainability and integrating existing knowledge about the effects of human activities on important ecosystem features.

As such, the Ecosystem Science Framework provides direction for moving the DFO research agenda to support integrated management of human activities.

4. Five-Year Research Agenda

4.1 Objectives and Goals

Excellent research is a vital component of the Science program. The Five-Year Research Agenda is designed to support current and emerging priorities and identify those areas that require new scientific knowledge in the medium and longer term. One of the key objectives of the research program is to create new knowledge and methods that will support the development of better advice required for policy and decision making and in particular, ecosystem-based management.

DFO's research program is multi-faceted and reflects the diverse demands for knowledge associated with existing, emerging, and increasingly complex science-based issues involving a variety of ocean industries, technologies, and a multitude of aquatic uses. In recent years, this demand for new types of knowledge has challenged the research program's capacity to deliver effective advice, products, and services. It has also served as a catalyst for reassessing and prioritising existing and future demands for scientific knowledge based on established and emerging priorities.

Identifying emerging research priorities and maintaining the flexibility to address a wide range of issues will continue to be a key role of DFO scientists. As such, DFO Science

must ensure it hires and retains balanced expertise that can respond to issues in an integrated ecosystem approach.

While the majority of DFO Science effort will be directed at making progress in particular priority areas, **a balance of critical skills will be maintained to ensure we have the necessary capacity to meet the ongoing research needs of the Department**. These skills are foundational; they support a wide variety of program areas and they are essential to the continuing viability of the DFO Science Program. Requirements to support regulatory responsibilities and advice include a wide-range of activities that also support fish, marine mammal, and habitat research.

4.2 Research Priority Areas

The following **research priority areas** reflect the research that is considered essential to address federal and Departmental priorities and public good needs for the next five years. They are strongly influenced by the Ecosystem Science Framework and include basic and applied research needed for developing **new** knowledge and improving the use of **existing knowledge**. Research priorities areas are interconnected and, to a large extent, integrated. Research undertaken in one area is expected to contribute to DFO's knowledge base in other areas. This is a key characteristic of the research agenda as it ensures research activities support an integrated management approach. The rationale for each of these priority areas is also important as it provides the raison d'être (e.g. describing the issues or problems) to carry out research.

The following priority areas of research are not ranked. It has been proposed that they be grouped under a limited number of themes, but no consensus has been reached at this point.

1 Fish Population and Community Productivity

Rationale

Effective management of fisheries requires an in-depth understanding of fish population and community productivities. Changes in the productivity and resiliency of key species may have serious consequences for the dynamics of entire ecosystems and the sustainability of fisheries. These changes might be triggered by several biological, physical and environmental factors as well as by human activities. With ecosystems changing and some species becoming at risk, research is needed to better understand factors and processes controlling population and community productivity.

Priority Areas for Research

- spatial patterns of spawning components, migration and movement at different life stages and age / growth studies of commercially important species
- impact of fishing on the benthos, species at risk and loss of genetic diversity
- bottom-up (primary and secondary production; food limitation; sinking of biological material to the sea floor) versus top-down (mortality by predation) ecosystem processes and the role of biodiversity in the control of productivity in benthic and pelagic populations
- food habits of important apex predators (e.g. marine mammals) and their impacts on commercially important species
- long term changes in carrying capacity of populations and ecosystems due to climate variability

- management strategies for species with limited knowledge and understanding of population dynamics

II Habitat and Population Linkages

Rationale

The alteration or destruction of fish habitat, either by human or natural means, may have lasting effects on fish populations, ecosystem resilience, and the sustainability of resource uses. Knowledge of the linkages between habitat productive capacity and population productivity (fish, plankton, marine mammal) is essential to understand the effects of anthropogenic and natural changes to habitat quantity and quality. Research is needed to better understand linkages between habitat productive capacity, population productivity, and biodiversity to be able to assess the effectiveness of mitigation and compensation measures for human activities.

Priority Areas for Research

- developing and testing methodologies that link population and community productivity to habitats and include concepts such as critical habitat and habitat-related thresholds (bottlenecks);
- quantifying and calibrating effects of human-induced and natural changes to habitats and the aquatic resources they support, including considerations such as sensitivity, resilience, intensity, duration, and reversibility of effects (spatial and temporal);
- developing best practices for measuring habitat impacts including:
    - methods for classifying and quantifying habitat attributes,
    - the identification of surrogates of productive capacity for major habitat types,
    - the validation of "pathways of effect" (relationships between harmful actions on habitat and populations),
    - the development of indices, models, and tools to support decision-making;
- assessing the effectiveness of mitigation and compensation policies for human activities negatively affecting habitats;
- integrating surveying and sampling methodologies (high-resolution bathymetry and seabed mapping, acoustic determination of substratum, remote sensing distribution, and conventional biota sampling) with habitat attributes and link them to population productivity and biodiversity.

III Climate Change / Variability

Rationale

Climate change means ocean change given the numerous physical and biochemical interactions with the atmosphere. **As climate changes, biological and physical conditions in the oceans are modified, which affect the sustainability of human uses of aquatic resources, as well as the safety of coastal areas**. Research is needed to better understand, detect, and forecast changes and provide scientific information for developing adaptation strategies.

Priority Areas for Research

- analysing climate change projections from the Canadian Centre for Climate Modelling and Analysis (CCCMA) coupled carbon-climate model and other international models and developing the next generation models at CCCMA
- downscaling global climate model projections and interpreting their impact on Canadian waters, including freshwater systems
- assessing flood risks and develop possible mitigation strategies
- analysing climate change impacts on contaminant pathways
- assessing the resilience of aquatic populations, from algae to marine mammals through:
    - study of spatial and temporal variations in life history characteristics of wild populations of key species in different physical and biological environments ,
    - study of key species' life history characteristic variations and ontogenetic changes in metabolism and potential biological-chemical-physical links related to, growth, maturation and behaviour through experimental work that simulates a variety of environmental conditions,
    - integration of field and lab information into simulations
    - inclusion of impacts of climate change on populations in fishing plans

IV Ecosystem Assessment and Management Strategies

Rationale

Integrated management of individual and multiple human activities requires management strategies that are risk-based and integrate information on the status of ecosystems and how human activities may affect ecosystem components and structure.

Priority Areas for Research

- developing different approaches (e.g. qualitative or quantitative) to evaluating the performance of management strategies for the ecosystem approach
- evaluating the performance of alternative management tools, including spatial management measures such as Marine Protected Areas and catch and effort limitations in harvest management, in protecting and ensuring sustainable use of both the targeted resources and other parts of ecosystems
- undertaking ecosystem modelling to consolidate knowledge of the ecosystem to support evaluation of management strategies
- developing and evaluating risk assessment methodologies to allow prioritization of human impacts on ecosystem components
- evaluating the performance of indicators in relation to conservation objectives of integrated management, including cumulative impacts
- developing ecosystem status reports to meet the needs of diverse clients of integrated management as well as the general public
- working with academia to develop research approaches that ensure consideration of the ecological, social, and economic dimensions of management are fully integrated in the evaluation of management strategies

V Aquatic Invasive Species

Rationale

Aquatic invasive species (AIS) are one of the leading threats to aquatic biodiversity and ecosystem health. They have the potential to displace domestic species that support traditional fisheries and have significant negative impact on aquaculture. Research is required to support the development of a regulatory framework and guide the development and implementation of management measures, including prevention, rapid response, mitigation, and control activities.

Priority Areas for Research

- developing ballast water treatment technologies
- refining predictive modelling of future invaders
- determining the best methods for early detection of new invaders and monitoring the spread existing ones
- developing rapid response and ongoing mitigation and control methods
- refining risk assessment methods to determine the risk of AIS to Canada's aquatic ecosystems
- understanding aquaculture interactions with invasive species such as tunicates

VI Aquatic Animal Health

Rationale

Diseases play a central role in influencing the viability of both cultured and wild populations of aquatic organisms. Disease outbreaks can have major ecological effects on aquatic resources and severe economic impacts for the sustainability of aquaculture species. To improve management of wild and cultured resources, research is needed on disease agents in nature and the potential risks and effects of disease transfer between fish.

Priority Areas for Research

- identifying the causal agents of emerging diseases that may compromise the health of ecologically and commercially significant wild and cultured aquatic organisms
- assessing the viability and movement of natural pathogens between cultured and wild aquatic animals (bi-directional)
- identifying major environmental physical and chemical (i.e., contaminants) factors and host physiology and genetic variables influencing aquatic animal health in nature

VII Sustainability of Aquaculture

Rationale

Long-term sustainability of aquaculture requires the development of ecologically appropriate production technology and environmentally sustainable practices. The successful implementation of DFO's Aquaculture Policy Framework requires scientific advice that better supports policy and decision-making. There is a need to carry out research on the development of high efficiency and environmentally friendly culture technology and environmental interactions.

Priority Areas for Research

- investigating disease transmission (bi-directional) between wild and cultured stocks and developing aquaculture vaccines
- developing biological and oceanographic models, collecting lab and field data to allow prediction of ecological effects (near and far-field) of aquaculture, and determining carrying capacity of aquaculture areas
- assessing the risk of genetic and ecological interaction between cultured, enhanced (e.g., hatchery) and wild fish, developing technology to minimise wild/cultured fish interactions, and assessing efficacy of captive breeding programs for endangered stock rebuilding
- assessing the impact of aquaculture on species at risk
- developing high-efficiency, environmentally-friendly, and industry-diversifying culture technologies for salmon, alternate fish, shellfish, and algal species
- using biotechnology, genomics, and genetics to improve commercially important traits (e.g., growth and reproduction) and assess changes from wild type for use in risk assessments

VIII Ecosystem Effects of Energy Production

Rationale

Energy development in Canada (mainly offshore oil and gas, hydroelectricity, and oil sands) is rapidly accelerating and is expected to be substantial in the near future. DFO Science is called on to evaluate risks, potential impacts, and mitigation options in these energy-related undertakings. Significant advances in research are needed to augment the existing knowledge base so DFO can participate effectively in the planning, evaluation, and implementation stages of these projects.

Priority Areas for Research

- Investigating the impacts of flow management and water level regulation on habitat and productivity in freshwater, estuarine, and marine environments and developing ecosystem-based limits for river water withdrawals
- assessing the effectiveness of fish passage criteria and systems
- assessing the impact of energy development on species at risk
- evaluating impacts of creating and operating large reservoirs and resulting large scale ecosystem changes

- assessing the impacts of activities related to hydrocarbon exploration, production, and transportation on marine and freshwater ecosystems with a focus on seismic noise, produced water, oil spills, and pipeline construction
- evaluating the effectiveness of mitigation and compensation measures designed to offset development impacts
- evaluating the impacts of tidal energy initiatives on oceanographic and ecosystem properties

IX Operational Oceanography

Rationale

Search and rescue operations, safe navigation, and the dispersion of pollutants and ballast water organisms all require now-casts and forecasts of the state of the ocean. To predict the ocean's present and future state (this is Operational Oceanography) research is needed to better understand oceanic processes and the ocean's circulation.

Priority Areas for Research

- modifying, applying and using oceanographic models
- developing flexible modelling systems that allow nesting of high resolution sub-domains in regions of specific interest
- developing data assimilation capabilities for physical and biological variables
- developing fisheries and ecosystem models, which link the state-of-the-ocean to population and ecosystem processes
- developing and applying models for high risk events like tsunamis and storm surges
- researching and developing very high-resolution models of near-shore zones

X Emerging and Enabling Technologies for Regulatory and Policy Responsibilities

Rationale

Science support for DFO's regulatory and policy responsibilities often depends on advanced technologies. On the other hand, **industry's use of new technologies may pose new challenges to DFO regulatory responsibilities.** As such, DFO Science must keep abreast of emerging technologies such as informatics, genetics, genomics, biotechnology, bio-remediation, geomatics and remote sensing. Research on new technologies is needed to:

- Enhance the ability of Science of performing research to gain new knowledge.
- Understand the potential effects of some technologies, such as modified organisms.

Priority Areas for Research

- identifying genetic markers for: rapid or remote species identification; strain and stock identification for species at risk; quantifying migration and behaviour of fishery species; and documenting responses to climate change and point source pollution
- developing techniques for analysing and interpreting data collected during multibeam surveys
- identifying and monitoring responses of aquatic organisms to environmental and anthropogenic stresses through population genetics and genomics

- developing technologies for mediating natural recovery in contaminated sites and for bio-remediation strategies for mitigation
- developing techniques to conduct bathymetric surveys of near-shore areas
- developing and applying bathymetric mapping and geomatics technologies to quantify seafloor properties, particularly in the nearshore zone, and of the effects of human activities on those properties
- identifying and evaluating aquatic animal models for enabling risk assessment science
- evaluating the efficacy of preventative and mitigative measures to prevent interaction between wild and novel aquatic animal strains
- developing technologies for remote sensing to detect, quantify and track the presence and abundance of particular individuals, species, species groups, or other ecosystem components, where that information is used directly in DFO's regulatory functions
- improving the effectiveness of accessing and using information required for DFO's regulatory responsibilities

5. Multidisciplinary and Collaborative Research

DFO Science recognises that it cannot support a shift to an ecosystem-based management approach by itself. Research to support ecosystem-based management will have to address increasingly complex questions and engage a broad range of research capacities. DFO Science does not have the capacity to develop and retain the necessary expertise, experience, and resources to support integrated management alone. As such, the purpose of the research agenda is to define DFO's research priorities and knowledge gaps to ensure the necessary expertise is identified.

The realigned DFO Science Program must effectively draw on the necessary expertise, wherever it resides. It is well recognised that, to be affordable and effective, DFO's aquatic research must be aligned with Canada's collective research effort and reflect the contributions of its partners in knowledge generation. DFO Science will partner with other experts and collaborate with other agencies wherever possible – both nationally and internationally – including other DFO sectors, academia, universities, Aboriginal groups, industry, non-governmental organisations, and other government agencies. Collaborative approaches and partners will be critical in the delivery of the DFO research plan.

Centres of Expertise (COEs) are an example of this collaborative approach. DFO Science is setting up COEs to maximise research in support of federal and departmental priorities and optimise the delivery of high priority research in partnership with industry, other federal departments, provincial and territorial governments, and academia. COEs enable DFO to support unique research requirements in areas of the Science program where national delivery and co-ordination is difficult due to the scope of the research requirements or specific, essential research outputs.

COEs are designed to enable DFO to address long-term research issues that cannot be addressed by a single region or institute by bringing together diverse scientific expertise, either in a geographic location or through a virtual network. COEs provide essential collaborative research that develops the necessary knowledge to support decision-making and policy development.

6. Research Plan

The research agenda provides strategic direction on how effort and resources will be focused to ensure their alignment with federal and departmental priorities. It also provides the basis for the development of a detailed research plan.

While developing the research plan, the focus will be on ensuring a balanced research program that is integrated, flexible and able to respond to new priorities, and built around long-term collaborations with our partners.

Following the discussions at the Science Renewal workshop that will be held in Montebello on February 6-8, 2007, a detailed research plan will be finalized and submitted to the DFO Science Management Board for consideration in the fall of 2007.